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Assessing the Effect of Aspen Competition on Lodgepole Pine Growth in the IDFdk3 &4 (EP1152)

INTRODUCTION

Historically broadleaf trees have been considered weeds when growing in conifer stands and have been removed from young stands to avoid the negative effects from competition. However, retention of some broadleaf trees in conifer stands is becoming a more accepted practice for a variety of reasons. The broadleaf component provides many biological advantages including enhancing soil properties and alleviating weather extremes on the understory conifers. It's presence benefits wildlife and increases the biodiversity of a stand. Broadleaf trees can have economic value, although in the current market, broadleaf trees with commercial value are not common in the IDF.

Even when the above factors are not considered, removal of broadleaf trees from a stand can be expensive. Therefore brushing should only be done when necessary. Determining the need for brushing when the primary objective is growing a conifer crop is the focus of this research.

The growth strategies of both species, but especially the conifer, will affect the relationship between the conifer and the broadleaf trees. This study focuses on lodgepole pine (*Pinus contorta*) and aspen (*Populus tremuloides*) which are two shade intolerant species with rapid initial growth. Both mature early compared to other commercial species. This species mix will have different management strategies compared to a species mix like spruce and aspen as spruce is shade tolerant, has slow initial growth rates and can successfully grow in an understory position.

The information in this note can be used by silviculturists when considering stand tending options and by foresters looking for options for increasing biodiversity in young stands.

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OBJECTIVE

The purpose of this study is to investigate and quantify the effects of trembling aspen competition on lodgepole pine in young stands, 5 to 15 years old.

METHODS

This study is a retrospective study that was established in 1992. Three stands were chosen in the IDFdk. Some stand statistics are given in Table 1. Fifty pine growing over a range of aspen densities from none to severe, were selected on each site. Height and diameter measurements were taken on these study pine and a 1.78 m plot (0.001ha) was established around each pine. Competing vegetation was assessed within this plot. including all herbs, shrubs and trees. All trees within the plot including broadleaves and pine were measured if they were over 40 cm in height. The trial was established in 1992 and measured in 1993, 1994 and 1997.

ANALYSIS

Pine growth was found to be well correlated to aspen density in a previous study conducted in the SBSdw1. (Newsome 1995). A similar relationship was found in the IDFdk data. Aspen density is an easy and quick variable to assess in the field. Therefore these analyses focused on the relationship between pine growth and aspen density. The pine growth variables include: 1997 height, 1997 ground level diameter, five year height growth and five year diameter growth. Information on the competing trees was collected in 1992 and compared to the 5 year growth variables (1992 to 1997) for the study pine. Aspen densities are divided into three height classes:

1. over 40 cm
2. 0.75 x study pine height and taller,
3. as tall or taller than the pine.

A non-linear regression has been used to fit the data. The model providing the best fit is $y=ae^{bx}$ where y is the pine growth variable and x is the aspen density. Each site was analyzed separately due to the different ages and tree heights.

The coefficient of determination (R^2), is a measure of the strength of the relationship between pine growth and aspen density. It indicates the proportion of pine growth, the dependent variable (y), that can be explained by the density of the competing trees, the independent variable (x). If all pine growth variation can be attributed to the density of competing trees , R^2 would equal one. In some plots, especially those with higher densities scattered pine were present. The number of pine competing with the study pine within the 1.78 m plot were minimal and tended to be in the plots with higher tree densities but the R^2 value did increase when both aspen and pine were considered as competing trees. Therefore the additional pine were included in the density values although it is still predominantly aspen competition.

Table 1. Mean 1992 age and heights for pine and aspen on the three sites.

			Pine		Aspen	
Site	Subzone	Mean Est. Age	Mean Ht. (cm)	Std Dev	Mean Ht.[1] (cm)	Std Dev
Meldrum Cr (MEL)	IDFdk3	12	197	55	337	108
Moffat Lake (MOF)	IDFdk3	8	131	34	308	115
Raven Lake (RAV)	IDFdk4	8	94	26	178	71

[1] Mean height of Aspen as tall or taller than the pine tree assessed.

Table 2. R^2 values from non-linear regression analysis of different size classes of competing aspen and pine versus study pine diameter and height growth.

	Five Year Diameter Growth (1992-1997) Site			Five Year Height Growth (1992-1997) Site		
Ht. of Competitors	MEL	MOF	RAV	MEL`	MOF	RAV
40 cm	0.34	0.40	0.31	0.19	0.33	0.21
0.75 x ht. of pine[2]	0.60	0.48	**0.41**	0.38	0.42	0.41
same ht. as pine	**0.63**	**0.51**	0.38	**0.45**	**0.48**	**0.41**

RESULTS

ASPEN SIZE AND IT'S AFFECT ON PINE GROWTH

With the exception of the Raven Lake site the relationship between pine growth and aspen density was strongest (i.e. has the highest R^2 value) when competing trees as tall or taller than the study pine were included in the density number (Table 2). For the Raven Lake data, including aspen between 0.75 x the height of the study pine to as tall as the study pine provided a slightly higher R^2 indicating that the smaller trees were competing with the study pine to a small degree. Including aspen from 40 cm tall to under 0.75 x the height of the pine reduced the R^2 value for all sites suggesting a poor relationship with pine growth.

A large proportion of the variation in pine growth in this study could be attributed to changes in aspen density where the aspen is as tall or taller than the study pine. Therefore further analysis was based on this subset of the data set.

ASPEN DENSITY AND IT'S AFFECT ON PINE GROWTH

Estimates were taken from graphs to determine when aspen densities started to compromise pine height and diameter growth. All sites had very similar thresholds even though growth rates and trees sizes differed. Pine height growth was reduced when aspen density exceeded approximately 5 competing trees per plot (5000 stems per hectare (sph)) and diameter growth generally declined when aspen density exceeded approximately 2 to 3 competing trees per plot (2000 to 3000 sph). In the SBSdw1, the study pine height growth also declined when competing trees exceeded 5 per plot and the diameter growth was reduced when competing trees exceeded 2 per plot.

The height to diameter ratio (HDR) also indicates the same threshold values. This value is calculated using height to ground level diameter. Using a ratio appears to eliminate the variation in height and diameter between sites. All sites are shown on Figure 1. The HDR remains low until 4 competing trees per plot are reached. At this point the overall average increases as the study pine diameter growth decreases. After 5 trees per plot, when height growth is affected, the trends are difficult to interpret. HDR may have potential for use as a tool to determine the need for brushing. However, HDR values can be affected by many different variables which can create a wide range of values within one density class (Figure 1.). In

[2] Pine refers to the study pine at plot center.

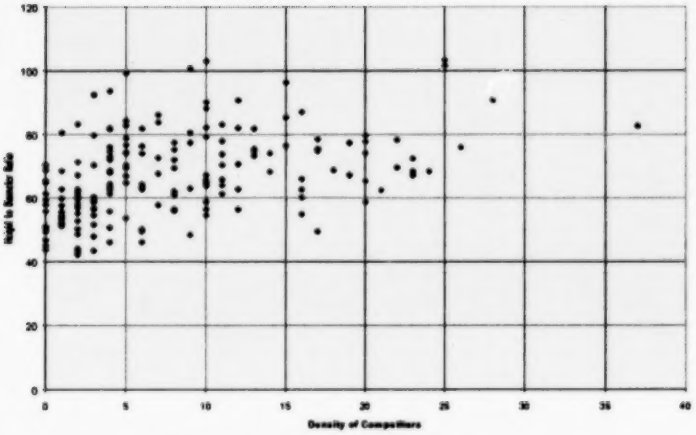

Figure 1. Height to diameter ratio of all three sites.

this scenario the mean HDR values for 3 or fewer competing trees per plot ranges from 56 to 61. At 4 competing trees per plot the mean jumps to 68. This jump would indicate a reduction in diameter growth and perhaps a need for brushing. Although HDR can be used as an indicator, it must be used in conjunction with other data to determine the appropriate treatment regime.

RECOMMENDATIONS:

1. Density appears to be a good variable to use when assessing levels of competition between aspen and pine.

2. Only aspen as tall or taller than the pine need to be considered as competition.

3. Reduction in pine diameter growth occurs when more than 2 to 3 aspen trees are within 1.78 m. This preliminary data suggests that brushing of pine-aspen stands is not needed until densities of pine and aspen exceed 3000 to 4000 stems per hectare (values include study pine).

4. Height to diameter ratios can be used as one of the tools to assist in determining the need for stand treatment . However, other stand characteristics must also be considered.

This is preliminary data from stands of a specific age, therefore the above data should be treated with caution until further data can confirm these findings.

REFERENCES

Newsome T.A. 1995. Assessing aspen competition on pine growth in the Cariboo Forest Region. In: Proceedings: NIVMA AGM January 18-19, 1995, Williams Lake B.C. C. Farnden (editor). Can. For. Serv. Prince George Dist. pp91-97.

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